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ELECTRIC CLOCKS.

THE invention of electric clocks was a natural consequence of that of telegraphs. The idea seems to have been realised nearly simultaneously, like many other inventions which are based upon a new discovery, by several philosophers, Wheatstone, Bain, and Steinbeck among others, and a plentiful crop of most ingenious mechanical contrivances for effecting the desired ends was the result.

Electric clocks had for their principal object the multiplication of the indications of a single standard clock on numerous dials, which could be placed at any distance from, but in electrical communication with, the standard clock. This, we say, has been the principal object in view, but it has not been the only one. Very many ingenious devices were invented, and much mechanical skill shown, in producing clocks which would work without springs or weights, the motive power driving them being a galvanic battery. Very partial success was the result of the numerous efforts made, the principal cause of failure being the want of an efficient form of battery to produce the motive power. Even this seems to have been overcome, or was thought to have been so, as an electric clock company, which manufactured clocks driven by a battery, will still be recollected by most of our readers.

A little careful consideration of the utility of such forms of clocks can hardly fail to give rise to the conclusion that such an arrangement can be nothing more than a philosophical toy, and probably it was regarded as such, for the trouble of keeping a battery in order can hardly compare favourably with the trouble of winding up a clock weekly, or even daily. The novelty and not the utility of the invention must have been, after all, the inducement which led the curious to invest in such a form of timepiece. If the driving power of a clock in the first instance had been a battery, and afterwards weights or springs had been brought forward, there can be but little doubt that the former would at once have been cast aside. Such forms of clocks are now things of the past, though attempts have been, and are made, to again introduce them.

The multiplication of the indication of a single clock on several dials has met with much more favour, and indeed may be considered as a successful invention. The great advantage which such a system possesses is that it is only necessary for the standard clock to be a good time-keeper.

The methods adopted for carrying out a system of the kind are threefold. By one method the standard clock synchronises the swings of the pendulums of the companion clocks, as they are called, with its own pendulum, the clocks still being driven by weights or springs. This was the plan invented by the late Mr. Alexander Bain, and it is one of the best systems which has been tried, though it has not come into extensive use. Another method, which is the most common, is that of moving the clockwork of the sympathetic clocks by a step by step motion, worked by an electro-magnet, through which intermittent currents pass, governed by the motion of the standard clock. Lastly, we have the system which has received an impetus lately through the energy of Messrs. Barraud and Lund, and which, although not new, has not long been put into a thoroughly practical form. In this latter system the position of the hands of the clock are corrected at every hour, and although it is not such a refined arrangement as that of Bain, it is, perhaps, the most practical form which has yet been introduced.

The synchronising of clocks by electricity, although it must hold its own in cases where the different dials are at long distances apart, yet is likely to have a dangerous rival in pneumatic clocks, which have proved so successful at the hands of M. Meyer, of Vienna, and also, we learn, previously at the hands of Mr. Wenzel, of San Francisco. Whichever system proves the best there can be no doubt that there is a very large field open for workers in this particular branch of horology. The wonder is that more has not been done, but, as in every other invention, there is usually a period of mushroom growth, and then a period of stagnation, to be followed in time by a steady, though slow, progressive advance. The idea of time being laid on like water or gas can hardly be regarded as otherwise than chimerical; but there is usually a grain of probability in prophecies of this kind, and it is quite possible to conceive that most large warehouses will in time take advantage of a system which will keep all their timepieces in order and accurate in their rate of going with but little expense.

INDIA-RUBBER CONSIDERED IN REFERENCE TO ITS APPLICATION TO TELEGRAPHY.

By THOMAS T. P. BRUCE WARREN,
Analytical Chemist to the India-rubber, Gutta-percha, and Telegraph Works Company, Limited.

THIS substance appears, under the name of caoutchouc, to have been known in Europe only as a very rare curiosity about the beginning of the eighteenth century. Nothing was known of its production, except that it was obtained from a tree

in America, till the French academicians went to South America (Quito) to measure a degree of meridian. M. de la Condamine, who was one of the party, sent an account of its source to the French Academy in the year 1736. Don Pedro Maldonado, who was another member of the expedition, found the same variety of india-rubber tree on the banks of the Amazon. M. Fresnau discovered an india-rubber-yielding tree at Cayenne, and forwarded an account of it to the French Academy in 1751. This tree, the *Siphonia guayanensis*, is the same as the *S. eastica*. No doubt a good supply of this substance found its way into France, for several French chemists, including Macquer and Fourcroy, examined its properties.

Macquer's experiments were published in the memoirs of the French Academy for 1768. In the seventeenth volume of the *Journal de Physique* is a paper on caoutchouc by M. Berniard, and the contributions to its history by MM. Grossart and Fourcroy appear in the eleventh volume of the *Annales de Chemie*.

Although our neighbours were so busy with this substance, the first published notice of it in this country did not take place till the year 1770, when Dr. Priestly, in a note to the preface of his "Treatise on the Theory and Practice of Perspective," says: "Since this work was printed off I have seen a substance excellently adapted to the purpose of wiping from paper the marks of a black-lead pencil. It must therefore be of singular use to those who practise drawing. It is sold by Mr. Nairne, mathematical instrument maker, opposite the Royal Exchange. He sells a cubical piece of half an inch for three shillings. He says it will last for years."

Looking at the unscientific reference to this substance from such an authority as Dr. Priestly, it is very certain that it was not very plentiful in England. The price per pound at this rate would be about *forty pounds sterling!*

It is a singular coincidence that just a little over one hundred years from the discovery of the French academicians the two very places in which this substance was first found should be connected with an india-rubber insulated submarine telegraph cable, viz., Para, on the Eastern Amazon, and Cayenne.

M. Condamine reported that the trees yielding india-rubber, which was called by the natives cahout-chou, were species of *Hevea* or *Siphonia*. It is tolerably certain that Condamine was not the discoverer of caoutchouc, as some writers suppose; but that he pointed out its source or origin there can be no question.

Almost every subsequent traveller on the Amazon has given some account of the collection and preparation of india-rubber, which shows that its collection, as practised by different tribes, in no way differs from that adopted by the more civilised population of Para; and, further, that it is found in great quantities on all the larger tributaries to the Amazon.

Whilst I was at Para I had the pleasure of the acquaintance of Captain Talisman, who accompanied Professor Agassiz's scientific expeditions through Brazil. This gentleman took me several interesting trips over the islands in the Para river, in which I gathered a great deal of interesting information respecting india-rubber.

My information on this subject, as well as the discovery of a new source of india-rubber, appeared about three years ago in the *Journal of the Society of Arts*; but as these numbers have been long since out of print, I hope on a future occasion to lay the same before the readers of this journal, with such notes as I have since been able to gather.

When it was proposed to employ india-rubber for submarine cables a great outcry was raised that the supply could never meet the demand, and that in a short time all the india-rubber-yielding trees would be destroyed. The absurdity of this objection is immediately apparent when we consider that, for about 10 degrees on each side of the equator, and extending entirely across the American continent, the trees yielding the very best quality of this substance are found in vast numbers, and that its collection does not entail either the destruction of the trees or injury to their growth.

The greater purity of Para rubber, due to its freedom from natural or accidental contaminations, over that of every other description, renders it well adapted for insulating purposes. I am not aware of the other kinds of india-rubber being tried; the Negrohead variety of the Para rubber has been used, but owing to the large quantity of woody matter which it contains it is scarcely suitable for insulating telegraph wires. As Para rubber, in its different forms, is the only kind employed for this purpose, I shall merely give the names of the other descriptions met with in commerce, with their botanical sources.

Para rubber.—The finest kinds of this rubber are said to be obtained from the *Siphonia elastica*, according to some authorities, and from the *Siphonia brasiliensis* by others.

A great difference in the quality of Para rubber has been noted since its demand has so largely increased, and it is not easy to explain this, unless we believe that other varieties of *Siphonia* are tapped for Para rubber.

The varieties from which india-rubber is said to be extracted are:—

Siphonia elastica v. Hevea guayanensis v. Siphonia cahuchu.
Siphonia brasiliensis v. Hevea brasiliensis.
Siphonia brevifolia, S. discolor, S. paucifolia, S. spruceana.
Siphonia rigidifolia, S. apiculata.
Castilloa elastica.
Ficus elastica, F. brassei, F. pandurafolia, F. indica.
Ficus macrophylla, F. rubiginosa, F. religiosa, F. australis.
Cynanchum ovalifolium.
Willughbeia edulis.
Vahea gummifera.
Euphorbia, several undefined species.
Tabernæmontana arcuata, T. utilis.
Landolphia florida, L. orvariensis.
Hancornia speciosa.

The author has shown that the juice of the Massaranduba, or Cow Tree, of Brazil, contains a very large quantity of caoutchouc. Probably the "Cream Tree," often described by travellers, as well as other "Milk Trees," owe their lactescence to the presence of caoutchouc. It is very necessary, however, to be careful, as some of the above plants belong to those classes containing the most deadly of our vegetable poisons.

Several plants of our own climate, with lactescent juices, contain caoutchouc, amongst which may be mentioned the dandelion, poppy, lettuce, and milk wort; but I am not aware of caoutchouc being found in any arborescent plant of these latitudes.

The part which this substance plays in plant life does not appear to have been studied. Whether it serves the office of pabulum, or is the result of excessive secretion of moisture from the leaves, we cannot tell. It is certain that it must be metamorphosed by the plant, for, unlike gums or resins, it does not exude in its natural state as a secretion.

It is a mistake to suppose, as some writers on this subject have asserted, that it is possible to bring some of these rubbers to such a state of perfection as to compete with Para in some of its applications. However carefully collected and prepared, I believe these trees, such as belong even to the *Euphorbiacea* and others, containing resinous or oily matters in their juices, will, in spite of all care taken in collecting and preparing their juices, remain unfit for submarine telegraphy, or for those purposes where a rubber constant in its character is required.

Those kinds of rubber containing fragments of wood and bark cannot be safely dealt with for telegraph work. The reason for this will be better understood when we treat of the manipulation of india-rubber.

The mode of collecting and preparing india-rubber in different countries no doubt produces greater differences in the product than we might expect to meet. The varieties of *Ficus* should give a clean and perfectly sound rubber, but who, looking at any ordinary sample of "Assam," "Madagascar," or "Australian," and probably a great deal of "African," would believe that they are all obtained from varieties of the *Ficus*?

In 1874, in the early part of May, when the steamship *Hooper* was on her way to Brazil with the Para-Cayenne cable, we put into Madeira for coaling, and whilst at anchor I was, through the kindness of Sir William Thomson, introduced to Mr. Blandy, who had two varieties of *Ficus* growing in his grounds. During the evening these trees were tapped, and as far as the appearance of the juice and the firmness of the coagulated film could enable me to judge, I saw nothing which struck me as being inferior to the juice of the *Siphonia brasiliensis*. The amount of juice collected during half an hour was a little over half an ounce. Most of the African rubber is collected nearly in the same parallels of latitude as the Australian and East Indian varieties, and yet no comparison can be made between them, even when collected from the same sources, so that we must look to the mode of preparation for the reason, or some clue towards it.

Para rubber is found in the English market under the following forms: "Bottle" rubber, so called from its form or shape; "Biscuit," which is met with more rarely, and in flat, thin pouches; "Negro-head," which consists of fragments of rubber conglomerated together whilst in an adhesive state, but coagulated; and "Scrap." The "Bottles" are formed by repeatedly dipping the mould or form into the fresh-drawn and liquid juice, drying each layer over a fire produced by burning the nuts of the Urucari palm before another re-dipping, so that this form of rubber has an evenly laminated structure, and is free from all matters foreign to the juice itself. I measured several laminæ in a piece of "Bottle" rubber, and I find the thickness varies as might be expected. This is due partly to the inspissated condition of the juice, and partly to the heated state of the bottle when dipped. The thickness of the films is about one-hundredth part of an inch. It is not an unusual thing to find a bottle measuring two inches thick; such a bottle would consequently require to be dipped at least 200 times. Now if we allow ten minutes for each immersion and drying, and assume that the native works only one-third of the twenty-four hours, we find that it requires about four days to build up such a bottle.

Telegraphy has certainly helped to raise the price of Para rubber, but so immensely has the general india-rubber trade increased, that whilst the price of this article was in 1861, when the writer was first engaged in this manufacture, as low as one shilling to fourteenpence per pound, it is now about two shillings and sixpence per pound. The price per pound when the Para-Cayenne cable was being manufactured had risen to three shillings and sixpence to four shillings per pound.

The following table shows the imports of india-rubber and gutta-percha. It is taken from "Phillips's Industrial Statistics."

Year	India-Rubber.		Gutta-Percha.	
	Quantity. (Cwts.)	Value.	Quantity. (Cwts.)	Value.
		£		£
1866	72,176	728,416	15,134	78,109
1867	79,756	696,377	15,289	92,945
1868	145,584	1,195,226	16,279	91,850
1869	136,421	1,134,585	15,398	95,616
1870	152,118	1,597,628	34,514	496,951
1871	161,085	1,684,281	26,211	199,337
1872	157,114	1,762,259	44,597	399,955
1873	157,436	1,746,095	54,898	479,316
1874	129,163	1,326,605	29,970	299,522
1875	153,564	1,570,558	19,627	149,223

This table will be found useful when we refer to the cables which have been manufactured during the corresponding years.

Travellers have given us very confused accounts of this smoking process, the impression being that the rubber is held over a smoky fire. Nothing can be more erroneous, for not a sign of fuliginous matter is given off from these fires, which are used merely as a source of heat to bring about the coagulation of the juice and the dissipation of the moisture.

As I have myself witnessed the process at Arapiringia, an island in the Para river, I can assure my readers that the statement of Para rubber being made up of alternate layers of soot and caoutchouc is most unreliable.

The "Negrohead" consists of the portions left after preparing the bottles, and the little scraps gathered off the trees where the incisions have been made, and of those portions which have become coagulated by standing or accident.

"Ceara rubber" or "Scrap" is yielded by a variety of the *Siphonia*, and is obtained by puncturing the trees, when the juice exudes and dries in little tear-

shaped balls. These are collected and rolled up into balls or blocks.

The *Castilloa elastica* is found in Venezuela, New Grenada, Ecuador, Peru, Panama, Costa Rica, Nicaragua, Honduras, Guatemala (?), and Mexico. The rubbers found in commerce, either under the names of Carthagena, Guayaquil, or West Indian are derived from this or other varieties of the *Castilloa*. None of these are fit for telegraph purposes, but still, if prepared with greater attention by the natives, it may admit of being used as a substitute for Para in many ordinary manufactures. This at any rate would tend to keep down the price of Para rubber.

The *Urceola elastica* and other varieties produce the rubber known in commerce as "Singapore." "Borneo" rubber is most probably produced from a species peculiar to the island. The tree is found in Borneo (?), Burmah, Java (?), Sumatra, Penang, and the other islands of the Malay Archipelago.

Ficus elastica.—This tree is found in Java, Madagascar, Australia, and Assam. The "Assam" rubber reaches this country in a very clammy and decomposed condition. "Madagascar" rubber is much cleaner, and in appearance totally unlike the "Assam." I believe we may look most hopefully to Australia for a good supply of a clean and sound rubber in a few years, and quite fit for telegraph purposes.

Cynanchum ovalifolium grows in Penang, and contributes to the production of the commercial india-rubber bearing that name.

Willughbea edulis and the *Vahea gummifera* are found in Java, Madagascar, and Assam.

Euphorbia.—Several leafless varieties of this plant yield caoutchouc. No one has given an account of the mode of its extraction. It is said to be extracted by boiling. It is the principal source of the more inferior kinds of rubber known as "African."

Tabernæmontana arcuata and *T. utilis* are both found in Demerara. The *hya-hya* or milk tree of Demerara is said to be a variety of *Tabernæmontana*, also the cream tree of Sierra Leone.

Landolphia.—Probably several varieties are found in the interior of the African continent. The rubber is of very good quality, but at present its supply is very small.

Hancornia speciosa.—This plant exists at Pernambuco, Maranham, and Bahia. Its habits of growth, &c., in being a tree growing in more upland districts, would lead one to conclude that it is not suited to yield india-rubber on a commercial scale. A copious supply of sap is always found in trees inhabiting swampy and damp soils, and this fact probably accounts for these trees parting with their juices without their vitality being seriously imperilled.

VISUAL TELEGRAPHY AND SUN FLASHING.

ALTHOUGH wherever possible the electric telegraph has superseded the conveyance of intelligence by means of semaphores, there are still frequent occasions when an efficient system of visual telegraphy can be used with the greatest advantage.

Most of us at some time or other must have felt the inconvenience of being unable to communicate (except by messenger) with some person within full view but sufficiently distant to be beyond the reach of the voice; or we might give as a case in point the instance of a vessel a short distance off the coast at night, with a heavy surf running and the commander desirous of communicating with friends on shore without the risk or trouble of sending a boat. Under such circumstances the ability to signal freely is almost equivalent to an extra sense, and confers such additional power that it becomes a matter for surprise that the subject has been hitherto so much neglected. Visual signalling might certainly be taught in the villages round our coasts with the greatest advantage, and a knowledge of it is so easy to acquire that officers in the mercantile marine should be compelled to render themselves proficient in its practice before being granted certificates of a superior class.

The facility with which we can make long or short signals equivalent to the dots and dashes of the Morse alphabet will be easily understood. During the night they can be expressed by flashes of light of varying duration, a common lamp fitted with a shutter or screen being all that is required for the purpose when the distance is not more than one or two miles. For long ranges the lime or electric light may be used with advantage, but the expensive character of these lights, together with other considerations, will always prevent their coming into general use for signalling purposes by private individuals.

During daylight large semaphores or screens, which by the assistance of telescopes can in clear weather be seen at a distance of several miles, would prove serviceable were the signalling-stations permanent, but as this is rarely the case flags are usually resorted to as the simplest and most portable substitute. A system of flag-signalling is adopted in the British army, but its usefulness is limited by the circumstance that it is often difficult to discover a distant flag party when their position is not known beforehand. The work of signalling is fatiguing, and the rate of communication necessarily very slow; this being the case, it is questionable whether the system would prove of much value to troops on active service, excepting to signal across rivers, or in a very mountainous district where mounted messengers would not be available.

We now come to the system of sun-signalling, brought to prominent notice some six or seven years ago by Mr. Henry Mance, and carried out by means of his ingenious and simple heliograph. The range of this instrument may be considered as unlimited, except by the rotundity of the earth; it can be worked at a speed of 12 or 15 words per minute with as much ease as an ordinary Morse key, and can communicate over distances when all other systems of visual telegraphy are utterly inefficient. No telescopes are required; one signaller is sufficient; and as any one acquainted with the Morse alphabet can work it, the instrument appears to be the best—in fact, the only substitute for the electric telegraph during daylight when the distance to be signalled over is so great that semaphores or flags of manageable dimension are quite invisible, even with the assistance of powerful glasses.

The natural objection that the sun is not always available of course suggests itself, and this, no doubt, has prevented the system being brought into general

use; but we might, on similar grounds, object to the sextant, which is not only dependent on the sun, but requires it at a particular time in the day. It is not pretended that the heliograph can be relied on with the same degree of confidence that we are accustomed to place in the electric telegraph, but intermittent communication is better than no communication whatever, and there are hundreds of places in the world where the occasional or systematic use of the signalling power provided by the sun would be a great boon; numerous contingencies will occur to the mind in which a portable little instrument possessing the powers of Mr. Mance's heliograph might prove of immense value—in sieges, for example, when ordinary telegraphs are absolutely useless the heliograph affords the means of communication between the beleaguered garrison and distant friendly forces in the field, over the heads of the besiegers—as a substitute for the submarine telegraph between islands where the traffic would not be sufficiently remunerative for a cable the heliograph might often be employed with good effect; also in mountainous districts, while the inhabitants of Fair Island would doubtless have appreciated its value had they been provided with an instrument on a recent occasion when, for several weeks, they, with a shipwrecked crew of a vessel, were completely cut off from all communication with the mainland.

Lately the Mance heliograph has been applied by the engineers of the Spanish army to establish telegraphic communication across the Straits of Gibraltar between Algeciras and Ceuta. For this purpose Fort Santiago on the Spanish and Mount Hacko on the Moorish side of the Straits were selected as the stations, the distance between the two being about 17 English miles.

On the 11th March at 8·0 a.m., the stations were in perfect communication. Although at the Hacko the sun presented itself somewhat behind the station, and, as is natural, very low in the heavens, the flashes were clearly perceived without the necessity of using a double reflection.

During the 12th, 13th, 14th, 15th, and 16th communication was perfect, and although at intervals the intensity of the sun was diminished by the interposition of clouds, the light was sufficient for the transmission of telegrams.

The despatches transmitted on the before-mentioned days were seventeen in number.

On the 17th and 18th the sun was only seen at short intervals, owing to a dense fog, which quite hid it, but taking advantage of the short periods in which it was visible, the necessary service was fulfilled by the sending of four despatches.

On the night of the 19th it rained incessantly, and also on the 20th until one o'clock in the afternoon, when the sun was visible for 45 minutes, during which time several telegrams were sent.

During the 21st, the state of the weather being exceptionally heavy, no communication was possible, but on the 22nd the weather cleared sufficiently to enable eleven despatches to be sent directed to Madrid, Seville, Malaga, Cadiz, and Algeciras, after which the service was discontinued, and the instruments dismounted.

The total number of telegrams sent was 38, several of which were composed of 200 words, and the greater part of 50.

The success of the experiments was so great that orders were issued for the permanent establishment of "Heliographic" communication between the two points.

The instruments used on this occasion were of the small field-pattern, designed for military service. As this and the pocket heliograph (which weighs only 3 pounds) is likely to come into general use, we purpose, at an early date, giving a drawing of the apparatus and a description of the manner in which it is worked.

Notes.

THE first regular telephonic line has been put in operation between the place of business of Mr. C. Williams, jun., Boston, Mass., and his residence in Somerville, a distance of about three miles. Mr. Williams states that it works well, and that "conversation can be carried on by it nearly as well as if those conversing were in the same room."

THE transmission of time by a pneumatic system has been in use in San Francisco since February 1874, where, in the London and San Francisco Bank Building, one regulator transmits the time to 14 dials. This invention (of Mr. H. Wenzel, of San Francisco) was patented in July 1873, and is so satisfactory that it has been also introduced in the Nevada Bank Building, with 26 dials; in the San Francisco Club House, with 8 dials; in Baldwin's Hotel, with 62 dials; and into a number of private houses. One of these clocks, with a most ingenious, original improvement on the escapement, termed "force constant," and connected with several dials, to which any number of dials in the same or adjacent buildings may be added, is now in operation, and can be seen at Mr. C. W. Schumann's office, 24, John Street, New York city.

THE French papers describe an invention for driving horses by electricity. The coachman is to have under his seat an electro-magnetic apparatus, which he works by a little handle. One wire is carried through the rein to the bit and carried to the crupper, so that a current once set up goes the entire length of the animal along the spine. A sudden shock will, we are gravely assured, stop the most violent runaway or the most obstinate jibber. The creature, however strong and vicious, is "transformed into a sort of inoffensive horse of wood, with the feet firmly nailed to the ground." Curiously enough, the opposite effect may be produced by a succession of small shocks. Under the influence of these the veriest screw can be endowed with a vigour and fire indescribable.

THE Post-office cable between Guernsey and Alderney having been repaired, telegraphic communication with the last-mentioned place has been restored. The steamer *International*, chartered by the Post-office for the purpose, has proceeded to Granton, there to repair one of the Forth cables, which has been broken for some little time; and it is understood that she will afterwards proceed to the north of Scotland, in connection with some repairs necessary to the Orkney and Shetland branch of the postal system of telegraphs.

IN Parliament, on May 31, on the motion for going into committee of supply being put to the House, Mr. Dillwyn called attention to the question of telegraphic communication between Lundy Island and the mainland, which has been the subject of communication between the Chamber of Commerce and the Postmaster-General; the amendment proposed was, however, negatived by a majority of 107 to 75, on the ground that such telegraphic communication would not prove remunerative to the Postal Department.

THE steamship *Hibernia*, belonging to the Telegraph Construction and Maintenance Company's fleet, has sailed to take up and repair in mid-ocean the long dormant 1865 Atlantic cable. This will prove to be one of the most interesting operations in submarine telegraphy ever undertaken, and there is no doubt it will be watched with interest by men of science, and by all shareholders in submarine telegraphs. It may be mentioned that the portions of the cable taken up at the shore end, after having been submerged for 12 years, are in such satisfactory condition as to inspire a large amount of confidence in the minds of those whose opinions are of undoubted weight and value.

THE cable between South Australia and Tasmania is interrupted. During the interruption, telegrams for Tasmania will be sent by steamer from Victoria without alteration in the rates of charge.

THE steamship *Seine* has just thoroughly repaired the Irish shore ends of the 1865 and 1866 Atlantic cables for the Anglo-American Company.

TRAFFIC RECEIPTS.

1877.	Anglo-American Co.	Brazilian Sub. Co.	Cuba Sub. Co.	Direct Spanish Co.	Direct U.S. Co.	Eastern Co.	Eastern Ex. Co.	Gt. Northern Co.	Indo-Euro. Co.	Mediterranean Ex. Co.	Submarine Co.	West Coast America Co.	Western and Brazilian Co.	West India Co.
	£	£	£	£	£	£	£	£		£	£	£	£	£
JAN. ...	37,780	11,469	2,311	983	13,530	42,580	24,147	12,663	... ...	... ...	9,668	2,533*b*	10,100	4,058
FEB. ...	32,330	11,606	2,214	784	15,520	35,050	19,645	12,800	... ...	... ...	8,624	2,980*c*	11,026	*3,932
MARCH ...	18,880	11,238	3,025	913	8,110	35,491	22,886	16,115	... ...	... ...	9,915	3,128*d*	11,643	... ...
APRIL ...	18,980	11,539	*3,900	1,011	6,930	39,861	23,068	16,151	... ...	... ...	... ...	2,362*e*	10,295	... ...
MAY ...	45,420	12,257	*3,900	997	17,370	46,309	25,445	18,427	... ...	... ...	... ...	2,170*f*	10,534	... ...

* Estimated. *b*, four weeks ending 13th January. *c*, four weeks ending 13th February. *d*, four weeks ending 10th March. *e*, four weeks ending 7th April. *f*, four weeks ending 5th May.

City Notes.

Old Broad Street, June 13, 1877.

IT is not surprising that Mr. William Abbott devotes a considerable part of his June circular to Telegraph Securities. We have nothing to say against the assertion that "Submarine Telegraphy is the greatest triumph of the British shareholder," and we feel absolute pleasure in complimenting Mr. Abbott on the appropriateness of his flowery language. We may yet live to see him engaged as a writer of government dispatches. Lord Beaconsfield must sometimes shiver at the want of finish which marks the documents for which certain servants of her Majesty are responsible—let him offer a retaining fee to Mr. William Abbott. But all Mr. Abbott's eloquence does not suffice to conceal the principal motive of his glorification of submarine telegraphy, Mr, Abbott thinks it is high time that the debt which is owing by the Government to the Cable Companies for services rendered in the East should be paid. He, moreover, like the bold man he is, suggests a way by which the obligation may be discharged. And thus we learn that what is wanted above all things is direct cable communication between the Cape and England. Hence, it cannot but be satisfactory to hear from so undoubted an authority that "the question is daily assuming increased importance, and when it is decided the sentimental grievance of the public as to the

Government granting telegraphic monopolies will be soothed away by one being freely given, *and with an Imperial or Colonial subsidy* (the italics are Mr. Abbott's), in connection with the growing colony at the Cape of Good Hope." Further, with that happy confidence which is characteristic of the writer, he affirms that "the route marked out on my submarine telegraph map will, no doubt, be the one selected; that is, from Aden to Natal, and thence to the Cape Colony." Yet, if Mr. Abbott's remarks had closed here, they would have been written to little purpose. Of course, as every one knows, Mr. Abbott, in common with other of his country's friends, is earnestly desirous that there should be no halt in the progress of submarine telegraphy. There are gentlemen who simply live to benefit their fellow-creatures. Mr. Abbott, we are quite sure, sympathises with such individuals—it is his nature. That being so, was it not a pity to show the cloven hoof so soon? We understand how desirable it is to increase the value of Eastern Telegraph shares—it may be urgent—and we can readily believe that the many will be fascinated by Mr. Abbott's forecast of the future. There remain, however, the discerning few, and, unless we mistake, the discerning few, reading Mr. Abbott's declaration that the line he expects the Government to establish "will of course become an immense feeder to the Eastern Telegraph Company," will refuse to be seduced.

There may or may not be ground for the declaration that the Government are likely to grant a telegraphic monopoly, not to speak of a subsidy, in order to unite the Cape with England by means of a submarine cable, but that is not a matter of urgent importance. The mere fact that a contingency is possible which would be "an immense feeder to the Eastern Telegraph Company" ought it is thought, to inspire the shareholders of the Eastern Extension with a desperate anxiety to sanction a certain prettily concocted scheme of amalgamation with the Eastern Company which Mr. Abbott and his ally Mr. Newton—and not Messrs. Abbott and Newton only—have long been trying to bring about. Blind indeed, according to Messrs. Abbott, Newton, & Co., to their own interests must holders of Eastern Extension Stock be if they neglect an opportunity of uniting with an enterprise which has such "an immense feeder" in view. It will be remembered Mr. Pender admitted at the ordinary general meeting of the Eastern Extension Company that the time for amalgamation had not come "at present," but we ventured to surmise that Messrs. Abbott & Newton had merely spoken too soon. Mr. Pender possibly now thinks the time for amalgamation *has* come. We shall see. Meanwhile, Eastern Extension shareholders will do well to receive Mr. Abbott's prophecies *cum grano salis*—and a very large one too.

Nor is the statement of the Eastern Telegraph Company, recently published, anything to go into hysterics about. The reserve fund is certainly to be increased; but the dividend remains the same as it was. Do the panegyrists of the Eastern Company forget that the war will not last for ever? Directly war ceases the receipts of the Eastern Company must inevitably decrease, and, unless war should unhappily spread, the earnings of the Company must now be as large as the shareholders can reasonably anticipate they will. Again, do the panegyrists of the Eastern Company forget that the receipts of the Eastern Company are at the present time augmented by the interruption in the Indo-European system at Soukum Kaleh? The interruption is merely temporary. When the traffic of the Indo-European Company is resumed, and the war is over, what sort of balance-sheet will be presented to the shareholders of the Eastern Company? We do not think that the prospect before the Eastern Company is in any case discouraging; for the revival of trade in the East will be the means of maintaining its receipts at a satisfactory figure. But there is no new reason why the Eastern Extension Company should desire amalgamation. It is possible holders of Eastern stock might themselves be disappointed at the results which would follow amalgamation. They will not, however, have the opportunity of being disappointed if the policy of Mr. Pender and his satellites is repudiated by the majority of Eastern Extension shareholders, as we believe it will be repudiated.

Mr. Abbott cannot be hard up for a subject—such a thing is an impossibility. We are, therefore, unable to excuse him for devoting so much of his space to that well-worn theme the West India and Panama Company. Every one knows the progress the company is making—it is almost visible on the hoardings at the railway stations—and Mr. Abbott's inflated estimates can do no good. Rather the reverse.

By the way, Mr. Pender may not be above copying the example of the West India and Panama Company in one, as it appears to us, most important matter. Why should not the gentlemen who are responsible for the "joint purse" arrangement between the Anglo-American and Direct Companies go in for the "word" rate? We make no charge, Mr. Pender, for the hint. We want no testimonial if, having acted upon it, you find it pay better than the existing system.

People are very slow to credit things they do not wish to believe. It is on this principle, no doubt, that Mr. Pender's confederates in the press resolutely refuse to entertain the idea that a new Atlantic cable company can be established. The public, we are assured, will not be so mad as to subscribe for any new cables on the basis of lower rates and a divided profit. We candidly admit that, if by any means whatever—cajolery, threats, entreaties, misrepresentations—these friends can persuade the public to let them monopolise the profits derivable from Atlantic cables, the means will be adopted. But the public has a way of thinking for itself, and it may come to the conclusion—and that as suddenly as decidedly—that it will not pay high rates when lower may be procurable.

The result of the *Hibernia's* trip will be watched with considerable interest. If the cable, which has so long remained inactive in mid-ocean, can be taken up and repaired it will be a distinct gain so far as the progress of submarine telegraphy is concerned, and men of science will find cause for rejoicing. We do not hold a brief for the Telegraph Construction and Maintenance Company.

So the negotiations between the Great Northern and Great Eastern Boards have, after all, abruptly fallen through, and amalgamation is quite off. We regret it most on account of the public. Great Eastern shareholders ought to regret it bitterly on their own account. Great Northern shareholders can afford to manifest indifference. It is obvious that the fault of the break-down in the negotiations, which were generally supposed to be practically concluded, rests with the Great Eastern Board. The Great Eastern directors wanted too much. Had the Great Northern directors accepted the conditions of a guaranteed minimum dividend in the Great Eastern original stock for ten years succeeding the date of fusion, they would have shown a sheer incapacity for their office. We cordially agree with the suggestion that the shareholders of the Great Eastern should insist upon a thorough investigation into the causes of this second break-down. It is not impossible that even now amalgamation may take place. But the board-room of the Great Eastern Company may have to be swept and garnished.

Proceedings of Societies.

THE SOCIETY OF TELEGRAPH ENGINEERS.

AT the ordinary general meeting of the Society, held on Wednesday, the 9th May, the chair was taken by Prof. ABEL, F.R.S., the President of the Society.

A paper on "Double-Current Translation" was then read by Mr. G. RISCH.

The author commenced by stating that it was not his intention to submit the subject of the paper as something original, there being several well-tried plans according to which double-current translation has been carried on for many years; but in the particular system carried out by Messrs. Siemens on the Indo-European lines, of which the paper treated, there were certain mechanical details which had not been published, and which might be of interest to the Society.

The aim of Messrs. Siemens in the system of translation seems to have been the introduction of only one pair of receiving coils into the circuit and the performance of all necessary switching by automatic apparatus. With that view the bracket of the sending key of the early days was provided with a vertical axle, so as to give the lever a horizontal motion, and it had to be held over laterally against the tension of a spring, for sending, an operation which was inconvenient. When released the key was drawn back by the spring into its position for securing, discharging the line to earth on its passage back to this position. The form of key which superseded the one just described may be compared to a pair of scissors with one shank insulated from the other when open. Both parts being held together by the hand of the operator when sending are brought into metallic contact and work together on one common horizontal axis like an ordinary sending-key, making contact up and down to zinc and copper respectively. The handle, the upper half of which is in contact with the line, ascends until its corresponding back part comes into contact with the relay-stop for the securing position, thereby breaking contact with the lower half, which communicates with the poles of the battery. During a portion of the time of both ascent and descent of this upper half to which line is attached, direct contact to earth is made by the action of a spring upon a little crank-lever before bringing the relay in direct contact with the line on the one hand, or before sending any fresh current into it on the other hand. In the latest form of key the scissors movement of the two parts of the key takes place horizontally instead of vertically, which is found to answer best.

The form of Morse inker employed contains an automatic releasing apparatus, so that the paper begins to run the moment signals are commenced to be sent. This action, at the same time, causes a mechanical switch to change position, which position is maintained as long as the clockwork continues to run. In the position of rest, the mechanical switch keeps the coils of the receiving instruments connected with their respective lines, while, when the train is in motion, it connects, during that time, the translating lever with the line to be translated into, and also the zinc pole of the main battery to the rest stop of the translating lever.

The coils of the recording instrument are placed in a shunt circuit of very high resistance, branching from the translating circuit. The inker, consequently, abstracts a small battery power from the translating main battery, and is thus an actual duplicate and faithful recorder of the signals sent into the line by the translating lever of the relay from the *line* battery.

Mr. RISCH then described by means of diagrams and instruments the working of the apparatus, pointing out certain advantages which the system possessed over others which had been tried. The system was shown to be one which could very easily be transformed into a double-current duplex.

The sections of line worked by the system were London to Emden, 391 miles, Emden to Kertch, 1,950 miles, Kertch to Teheran, 1,451 miles, making a total of 3,800 miles.

At the conclusion of Mr. RISCH's paper, there being no discussion, a paper was read by Mr. LANGDON, the acting secretary of the Society, on "Jablochkoff's Electric Light." In the discussion which followed, Mr. APPLEGARTH gave some details concerning the application of the light to illuminating purposes in Paris, and a unanimous votes of thanks to Mr. RISCH and Mr. LANGDON for their papers having been passed the meeting then adjourned.

THE INSTITUTION OF CIVIL ENGINEERS.

THE concluding meeting of the sixtieth session of this incorporated Society was held on Tuesday, the 29th of May, the president, Mr. GEORGE ROBERT STEPHENSON, in the chair, as he has been on all occasions when the members have assembled during the past twelve months, emulating in this respect the example of his predecessors, as well as of the members of the Council generally, who often at great personal sacrifices make it a point of honour and of duty to attend, thus contributing in no small degree to the success of this highly popular and useful body. During the session there have been twenty-three ordinary meetings, when twelve papers have been read and discussed with that completeness which always characterises the proceedings of this Society. A brief summary of these communications will show the varied branches of engineering which have occupied attention. In regard to the river Thames, it was demonstrated that the changes in its condition during the last half-century, due to the removal of obstructions and other improvements, had added 33 per cent. to the above-bridge tidal volume. The lighthouse system of Japan, the result of treaties between the European powers and that empire, had led to the establishment of thirty-six lights, the general form and dimensions of which were described, including the precautions adopted to obviate the effects of earthquake shocks. The repairs and renewals of locomotive engines on some of the leading lines of railway in this country, as well as on the Continent and in the United States, were minutely analysed, and the causes contributing to the fracture of railway tires were the subject of theoretical investigation. The construction of street tramways, and the use of mechanical motive power on them, was also submitted for consideration. In respect to what might be termed municipal engineering, the supply to be derived from the chalk water system in and around London had been elaborately treated, while the sewage question had been reviewed, and certain conclusions set forth as to the applicability of various systems and processes under particular circumstances. The history of the modern development of water-pressure machinery was succinctly traced, and the different forms of machines which had come into use were described. The transmission of power by water, steam, compressed air, shafting and ropes, was compared, and in the result it was contended that where the work to be done was intermittent, the hydraulic system, on the ground of speed, safety, and convenience, was superior to any other. Plans for the combustion of refuse vegetable substances under steam boilers were discussed, as it was urged that the only method of rendering the use of steam power universal,

particularly for agriculture, was to construct the boilers so as to utilise the local supplies of combustible materials of every kind. In a deep boring for coal at Scarle, in Lincolnshire, the carboniferous strata had been reached, and it was deemed desirable that the boring should be continued, as the determination of the eastward extension of the Yorkshire coal-field was important, both economically and from a scientific point of view. The series of papers was terminated by a description of an economic method of manufacturing charcoal for gunpowder. Besides the ordinary meetings, there had been eleven supplemental meetings exclusively for students, when as many papers were read and discussed. The attendances at all these meetings had far exceeded the average. The annual publications now comprised four volumes of "Minutes of Proceedings," each of nearly 400 pages, and amply illustrated. During the session there had been an effective increase of 2 honorary members, 69 members, 94 associates, and 58 students, the numbers of these several classes being now 16,939, 1,691, and 458 respectively, together 3,104, as against 2,881 at a similar period last year.

PHYSICAL SOCIETY—26TH MAY, 1877.

Prof. G. C. FOSTER, President, in the chair.

THE following candidates were elected members of the Society: Lt.-Col. A. C. Campbell, of Blythswood; Dr. H. Debus, F.R.S.; Mr. W. T. Thiselton Dyer, M.A., B.Sc.; W. Jack, M.A.; and Capt. Sale, R.E.

Lt.-Col. CAMPBELL explained and exhibited a double slit which he has employed for measuring the distances between the lines in the spectrum, and finds of great service in cases where the illumination is so slight as to preclude the possibility of using the ordinary micrometer. One slit remaining stationary, the other can be moved at right angles to its direction by means of a very delicate micrometer screw of 200 threads to the inch. If, now, a reading of the micrometer be taken when the slits are superposed, and form one continuous slit, and a second reading when any given line has been superposed upon any other line at a moderate distance from it, the difference between these readings will enable us at once to ascertain the distance between the lines, if the micrometer be calibrated in terms of the spectrum, as seen in the observing telescope. The author has made several measurements with this apparatus, and finds it to be capable of extreme accuracy; but it is, of course, essential that the movable slit remain within a moderate distance of the axis of the collimator. He then described a simple arrangement for automatically fixing a prism, when placed on the table of a goniometer, at the angle of minimum deviation when different coloured rays are under examination. To the arms which support the telescopes of the goniometer are attached two short links of equal length connected at their extremities with a nut sliding freely on an arm, which is fixed radially to the centre table of the instrument. The prism is held on the table with its base at right angles to this arm, and it thus remains adjusted for all the rays of the spectrum.

Mr. O. J. LODGE then read two papers by Profs. AYRTON and PERRY, jointly, of the Imperial College of Engineering, Japan. The first contains an account of an elaborate series of experiments on "Ice as an Electrolyte." They state, as a result of their experiments, that the capacity per cub. cent. of ice at—13·5 C. is 0·002 microfarad, and the specific inductive capacity is 22,160 (that of air being called unity), while that of water at 8·7 C. is about 2,240 times this amount. Commencing with ice at—13·6 C., the temperature was allowed to rise, and the conductivity determined by galvanometer readings. From these a very regular curve was deduced, which shows that the conductivity increases regularly, and that there is no sudden rise in passing from the solid to the liquid state. The apparatus was also employed for determining the electro-motive force of polarisation currents at different temperatures by replacing the copper by a zinc disc.

The second communication contained suggestions for experiments, "On the Viscosity of Water and other Liquids." It is accompanied by working drawings of an apparatus which the authors have designed for determining the relation between the viscosity of a liquid and the velocity of a surface moving in contact with it. They have, however, no facilities for making such an apparatus, and therefore place it at the service of any one who may be willing to study the subject.

Correspondence.

London, June 12th, 1877.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—We perceive that the long threatened letter from Mons. C. Clamond, of Paris, has (after a due manipulation on this side of the Channel) at length appeared in your Journal of the 1st instant, and we feel assured that you will readily accord to us sufficient space for our reply to this laboured attack upon us and our patent thermo-piles.

We venture to think that such facts as we are now prepared to set forth will be of some interest to all those who know and appreciate the varied uses to which a really good and *durable* thermo-pile may be applied.

In the letter referred to Mons. Clamond starts on the altogether erroneous assumption that we have attempted to improve upon *his* patent piles, an illusion which we will at once proceed to dispel.

His patent of April 1874 is stated in the specification to be "based upon the thermo-electric-generator patented in England by Messrs. Mure & Clamond on the 7th October 1868, number 3060, under the title of Improved Means and Apparatus for Generating Electricity by Heat." (Which latter patent lapsed in 1875, both in England and in France, as the Government *dues* were not paid.)

It is almost needless for us to state that a great number of thermo-piles (both patented and otherwise) were known and used many long years before either of Mons. Clamond's patents were issued.

Piles, with bars made of antimony and zinc alloy, and of various other metals, piles made in circular form, heated by gas, and by means of Bunsen burners—all these were in use long prior to his!

He was but following in the footsteps of those inventors who had preceded him! He has no claim whatsoever to any monopoly of credit in this direction; for in sober truth he is only *one* amongst the many who have essayed to make a really durable thermo-pile, and signally failed!

The patent of 1868 having *lapsed*, that of 1874 (being based on it) was deprived of its support, and was, to all intents and purposes, thereby reduced to the *two* "claims," upon which he lays so great a stress in his specification, viz.—

First. Sealing or fitting negative plates of thermo-electric piles, as described and shown in the accompanying drawings.

Secondly. Casting bars of thermo-electric piles, in moulds previously heated almost to the point of fusion of the thermo-electric material from which they are to be made, as described and shown.

Let us now examine these two "claims," and mark what results are obtained by employing them. The *first* is a modification of the "sealing or fitting" (shown in the patent of 1868, and consists of a loop or loops) in the ends of the positive-plates, which being embedded in the ends of the negative bars (in casting) was supposed to be always filled by the metal of those bars, and thus effectually "connected" with them.

In practice, however, this desired result cannot be depended upon, as very frequently the metal does not run into and through these loops, but leaves them hollow, and consequently the metallic "connection" is *very* imperfect.

This most unsatisfactory result is no doubt in some degree caused by what we will next explain. The *second* claim is simply an astounding error, inasmuch as a mould, heated to so high a degree as is distinctly indicated, produces *disastrous effects*.

The melting-point of the marcus, or antimony and zinc alloy, is over 800° Fahr.; and if the mould be heated even up to no higher than 600° Fahr., what happens to the tin with which the sheet-iron positives are coated?

Tin, as is well known, melts at a heat under 450° Fahr., so that if the moulds are heated to that temperature, the tinned-iron undergoes a change; its tin becomes *oxidised*, and a good metallic connection with the negative bar is rendered absolutely impossible.

These are such simple facts that we can scarcely imagine even Messrs. Clamond and Co. will be sufficiently rash as to attempt to gainsay them!

But there is something more than this even which these clever gentlemen appear to be still in ignorance of, and that is the *condition* of the negative bars themselves, when cast in accordance with this "claim"; the declared object of which is to obtain bars free from those cracks which, "imperceptible to the naked eye, grew larger, and the oxidisation penetrated to the interior of the bar, which became more and more resistant . . . . and rapidly rendered the pile useless."

Now it can be distinctly proved that this most essential object is *not* attained by this mode of casting, for almost every bar so cast has one or more, sometimes many, of these minute cracks, which so speedily lead to their utter destruction.

We can therefore say, without any fear of contradiction, that these *two claims*, upon which M. Clamond's patent really hinges, are *altogether worthless*.

We next come to what M. Clamond terms his mode of heating his piles, and we must here remark upon a fact, to which the hundreds who have used them can most painfully testify, viz., that even if his bars or couples were ever so perfect when built up into a pile, his very erroneous method of heating them cannot fail to insure their more or less speedy destruction, exposed as they are, not only to the fierce jets of flame issuing from the Bunsen or Multiple burner, and impinging directly on their inner ends, but to the combined influence of atmospheric air, the sulphurous products of combustion, damp arising from condensation, &c.

The question naturally presents itself, "What has been the career of these singularly ill-conceived piles, of which some 500 to 600 are said to have been made and sold in France and England?" The only answer which can truthfully be given to this question is that some worked for a few weeks, some for a few months, and we believe we are correct in saying that *they have all failed and ceased working*, except eight or ten, which, we hear, have been recently patched up in the hope of being able to use them a while longer! We scarcely imagine that M. Clamond can find in these deplorable results anything to plume himself upon, and we are amazed at his silly presumption in charging us with borrowing from and making a bad copy of *his* apparatus!

We have adduced some of the actual facts of the case (as relate to his patent)—facts far too well known to be for a moment disputed, and with these before us it must be quite clear that no one possessed of any practical knowledge of the subject would dream of *borrowing from* or *copying* such an abortive patent.

It is almost superfluous to add that, seeing the fatal defects which characterised his apparatus, we have worked out our objects without any reference to him or to his patent.

It is clearly open to all the world to make every legitimate effort to obtain a really efficient and durable thermo-pile; there is at present a very great necessity for such a battery, and so important a requirement as this is not likely to be postponed, nor *progress* in this direction to be stopped, merely to gratify this French gentleman and his friends in this country.

But M. Clamond professes to have effected an improvement in the mode of heating his piles "since June 1875," by furnishing them "with a heating chamber, either in iron or earthenware, which have been supplied to the public and various manufacturers;" but this so-called "improvement" he magnanimously abstained from patenting! Did not M. Clamond "borrow or copy" this mode of heating from Lieut.-Col. Baker's patent of June 1866, in which is described and claimed a method almost identical, the especial difference being that Col. Baker does *not* expose his bars to the injurious action of the products of combustion? As M. Clamond *retains* this evil action, it may fairly be asked whether, in "borrowing" from this old patent, he has not succeeded in producing a "*bad copy*" of it.

To allege that our heating chamber (against the outside of which the inner ends of our couples directly abut) is in any way similar to either of the foregoing is simply a reckless and unfounded assertion, which will deceive nobody.

We are well aware of the particular *object* in making this and the numerous other incorrect assertions contained in the letter referred to, and can well afford to treat them as they deserve. The validity of our *two* patents, and as to whether they do or do not infringe on his patent, are clearly subjects of discussion altogether unsuited to your columns. Suffice it, therefore, to say that we are thoroughly well "advised," and are quite prepared to meet any question of that kind. The verbose and singularly crude dissertation on the effect of our *long positives* (or positives with the "elongated tongues") is, no doubt, well calculated to mislead for a time a large majority of your readers; but we ourselves can only view such delusive arguments as a clear indication that the writers are only able to propound untenable theories, instead of adducing reliable data arising from practical experiments.

We understand their argument to be, that by the employment of our "elongated tongue" we lose at least *one-third* of the electro-motive force of our bars, although, from the diagram which they give, they insinuate somewhat broadly that we actually lose *two-thirds!* We are also told with uncompromising severity that "the disposition of the bar is against all the known and admitted laws, and only proves their [*i.e.* our] inexperience"!

Very good! these are clear and distinct issues which we readily accept, and we have some confidence in our ability to show, before we conclude this letter, that (all *inexperienced* as we are) we have, nevertheless, by numerous experiments proved conclusively that these "known and admitted laws" do not apply to the conditions under which our bars are constructed! Their

arguments are based upon the erroneous assumption that the "tongue" *inside* the bar corresponds in its action to the conductor C D, placed *outside* the bar (as shown in the diagram);* but if that theory be correct, how is it that a bar, having an E.M. force of ·0876 V., should, when heated at the reverse or outer end (carrying the tongue), give a power of ·070 V., thus showing a loss of only a little over 20 per cent., the temperature of the extremities of the bar being about 800° and 70° Fahr. respectively? It likewise appears from their arguments that if the outer and inner positives are cut out of one piece of metal, so that a strip runs through the whole length of the bar, no current would be obtained! This, however, is *not* the case; and a year ago we built a small pile of bars constructed in that manner, which gives an E.M. force nearly equal to half *that* yielded by one having no "tongues."

This curious little pile is in excellent order, is frequently used for laboratory purposes, and has just been exhibited at a provincial exhibition of art and industry. A bar having one of these *continuous* positives gave, when tested a few days ago, a potential of ·0452 Volt., which represents a power very nearly approaching the ·05 V. of which M. Clamond seems so proud. This may possibly be something new to him and to his coadjutors in this country, and they may be yet more startled on learning from us that even when the positive is formed of one strip of iron the *entire width of the bar throughout*, a force of ·0243 Volt. may be obtained. The 150 bar pile exhibited by us at the Royal Society's *Soirée* was finished and tested in *great* haste only the day before, and we stated its E.M. force to be exactly as we found it; but afterwards, on readjusting the burner, it gave a greatly increased force.

Messrs. Clamond and Co.'s argument in regard to this pile consequently falls to the ground, and has no value whatsoever. Subsequently we made another pile, which was professionally tested by Messrs. Latimer Clark, Forde, & Co., who furnished us with the following certificate:—

"Dear Sirs,—We have much pleasure in stating that we have tested your Patent Thermo-Pile (which comprises the improvements contained in your second or latest patent), and we now beg to certify as follows:—

"The Pile consists of 120 elements, each weighing 2030 grains. The negative bars being made of your new alloy, and the outer ends of the positive bars having your novel form of tongue or elongation.

"The heating arrangements seem very excellent and efficient, and, in our opinion, the mode of construction appears calculated to secure great durability. The results of our tests are as follows:—

"Electro-motive force ... ... = 5·27 Volts.
"Internal resistance when in action = 1·93 Ohms.
"Hence the current generated by the Pile, when the latter is on 'short circuit,' is equal to 2·73 Vebers per second.

"We are, dear sirs,
"Yours faithfully,
"CLARK, FORDE, & CO.

"C. & L. WRAY, jun., Esqrs."

Now this result agrees entirely with that obtained by ourselves, the preceding pile being much in the same ratio; and here we find that 23 bars go to the volt, which with such a low internal resistance is no doubt a very good working result, considering that absolute safety to the bars is assured; but we can without difficulty furnish piles yielding *one volt from each 16 bars*, at a certain increased cost.

Whether we shall be able to accomplish *better* things than this remains to be seen.

* THE TELEGRAPHIC JOURNAL, p. 131, No. 104.

M. Clamond's pretension is, that he can easily obtain in practice one volt from 20 bars, although it is perfectly well known that *on an average* his piles did not yield more than a volt to 30 bars, and even at *that* quickly ran their course to destruction! On the other hand, we also know as a fact that they *can* be made to yield a volt to 20 bars, and that they have frequently done so; but this only brought about a *sudden* instead of a *lingering* death.

So much for his pretensions on this score, nor can we congratulate him on his accuracy in regard to the use of "wire gauze" inside our burner, inasmuch as we have a practical experience of some duration to oppose to his erroneous assertions.

The remarks relative to our pile of 60 broken bars betray the same amusing confusion of ideas as characterise his other criticisms, consequently they need no further notice from us.

The same applies to his allusions to our mode of regulating the admission of air to the annular space inside our fire chamber, which is nothing less than an absurd perversion of the actual facts.

It now only remains for us to state what we have done to prove our position, in regard to the effect of our elongated positives, and we venture to invite especial attention to what follows.

At the meeting of the Society of Telegraph Engineers on the 22nd of November last, we stated, in reply to a question by Prof. Foster, that in the test pile we had built we found, to our surprise, that bars having the "tongue" gave a slight increase of E. M. force over those without it.

Numerous experiments subsequently made on single bars led us, however, to doubt the reliability of the conditions under which that little test pile furnished that result, as we found a slight *decrease* of power, but we considered it was too insignificant a loss to be placed against the great advantages gained by its employment—hence we retain it.

But with a view to place the question beyond all controversy we have just made and had tested, by Messrs. Latimer Clark, Forde, & Co., a small pile, consisting of 36 bars of 2030 grains each, in three zones of 12 bars each.

The negatives are made of our *new alloy*, and cast in moulds in alternate bars, and built in alternately (*i.e.*, one short and then one long positive, and so on), in order to insure the utmost possible exactitude.

The report of the comparative results of this trial, given by these eminent electrical engineers, will not only be read with great interest, but will command all the weight it so well deserves. It will be remarked that all the bars exhibit a very high E.M. force; but that those with the *tongues* show a slight comparative loss, and on the other hand a decided gain in "resistance." Consequently, taking also into account their other advantages, it cannot be denied that their employment is decidedly advisable.

We may mention that bars made of our new alloy are *much* stronger, less fusible, and of a lower internal resistance than the usual antimony and zinc alloy.

We beg to append the report referred to, and remain,

Yours faithfully,
CECIL WRAY,
L. WRAY, jun.

(COPY OF REPORT.)

"7, Pope's Head Alley, Lombard Street,
"9th June, 1877.

"DEAR SIRS,—Since our letter to yourselves of the 5th instant, we have had the opportunity of testing the electro-motive force and resistance of the elements composing your new thermo-pile, and of comparing

those having the elongated tongue with others without that appendage, but similar in all other details of construction. In speaking of the former kind we propose using the term 'long positives,' and of the latter kind 'short positives.'

"We learn from you that the bars with long and short positives, with which we experimented, were cast simultaneously; that is to say, that the positive bars, with and without tongues, were arranged in the moulds alternately, and that the alloy for the negatives was then poured in, thus securing a fair average composition in the negative bars of the respective elements.

"We observe that the pairs as arranged in the experimental pile are disposed in three layers of twelve elements each, and that in each layer the elements with short and long positives are arranged side by side, and alternately.

"The heating effect must, therefore, be quite fairly distributed, and applied impartially to the two kinds of elements.

"The eighteen elements with long positives are connected in one series, and the eighteen elements with short positives in another; the poles of each series being brought to separate terminal screws.

"The resistance of these series, before lighting the gas, was as follows:—

"Long positives, 0·266 ohms.

"Short positives, 0·308 ohms.

"After the gas had been burning for forty-five minutes, the electro-motive force of the series was:—

"Long positives, 0·977 volts.

"Short positives, 1·050 volts.

"One hour and twenty minutes after lighting the gas the resistance observed was:—

"Long positives, 0·392 ohms.

"Short positives, 0·438 ohms.

"At the same time the electro-motive force was:—

"Long positives, 1·133 volts.

"Short positives, 1·226 volts;

the latter values remaining sensibly constant, and appearing to be the limit attainable with the temperature employed.

"From the above it will be seen that, whilst in the series with long positives the electro-motive force appears to be reduced 7 or 8 per cent., the "internal resistance" is also reduced, when the pile is in action, about 12 per cent.

"With the long positives about 16 elements are required to produce a difference of potential of one volt, with the short positives about fifteen elements; but we consider that the great gain in mechanical strength secured by the use of the tongue would, in practice, more than compensate for this difference.

"We remain, dear Sirs,

"Yours faithfully,

"CLARK, FORDE, & CO.

"C. & L. WRAY, Esqs."

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—To obtain the insulation resistance per mile of an open telegraph line or submarine cable it is usual to multiply the *total* insulation resistance by the mileage of the line; this result, it seems to me, cannot give correct results, as it assumes that the leakage throughout the wire is the same at all points, which is clearly not the case, as the quantity leaking out diminishes regularly from end to end—the nearer portion of the line is, in fact, tested with a higher battery power than the further portion. I have looked in vain through most of the existing text-books for a formula which would give the true method of obtaining the result, but without success. If you could furnish me with what I require I should feel obliged, should, indeed, my theory be a correct one.

ELECTRICIAN.

[Our correspondent is perfectly correct in supposing that the total insulation resistance of a line multiplied by its mileage does *not* give the insulation per mile. The following is the true formula for obtaining the result he asks for:—

$$i = R_i \frac{R_e}{r}$$

where i = the insulation per mile.

R_e = the *total* resistance when the further end of the wire is to earth.

R_i = the *total* resistance when the end is insulated.

r = the resistance of a mile of the conductor, supposing its insulation to be perfect.

Thus, supposing we were testing a line 200 miles long, whose conductor was a No. 8 galvanised iron wire; this wire, as a rule, has a resistance of 13·5 ohms. per mile, that is, r = 13·5.

Supposing also the total resistance (R_e) of the line, when the end was to earth, was 2,600 ohms., and the total resistance (R_i), when the end was insulated, 3,000 ohms., what would be the insulation resistance per mile of the line?

We have

$$i = \frac{2{,}600 + 3{,}000}{13{\cdot}5} = 578{,}000 \text{ ohms.}$$

The result which would have been obtained by the common process would have been

$$3{,}000 \times 200 = 600{,}000,$$

which is higher than the true result.

The difference in the case of long lines would be very much greater.

It will be noted that the length of the line does not apparently come into the equation, but the fact is that this quantity is represented by

$$\frac{R_e}{r}$$

What we have to do in fact, in order to obtain the insulation per mile of a line, is to multiply the total insulation, not by the *true* total conductivity divided by the true conductivity per mile, which is the same thing as the mileage, but by the *observed* total conductivity divided by the true conductivity per mile.]

[We do not hold ourselves responsible for any opinions expressed by our correspondents.—ED. TELEGRAPHIC JOURNAL.]

ERRATUM.—On page 130, No. 104, second column, nine lines from the bottom of the page, read

$$R = \frac{9{,}000 \times l}{s}$$

for

$$R = \frac{9{,}000 \times s}{l}$$

To Correspondents.

*** Duly authenticated contributions, theoretical and practical, on every subject identified with the interests of which "THE TELEGRAPHIC JOURNAL" is the organ, will always command attention. Anonymous correspondence will be wholly disregarded. Literary communications and books for review should be addressed to the EDITOR; business communications to the MANAGER, 10, Paternoster Row, E.C.